All Cracked Up

Reporting Category Geometry
Topic Plane Figures

Materials

- 10 cm x 10 cm squares of construction paper or square pieces of origami paper
- Scissors
- "All Cracked Up — Area and Fractions with Tangrams" one copy for each student
- A letter-size, three-hole-punched envelope for each student to hold tangrams for future projects

Note: If scissors are not available, cutting may be replaced with licking and tearing.

Vocabulary

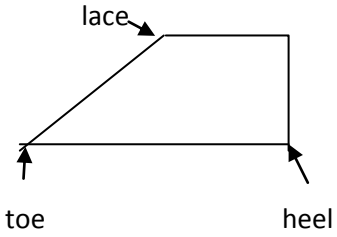
plane figure, square, rectangle, triangle, parallelogram, rhombus, trapezoid, fraction, vertex, congruent, parallel, area, isosceles

Student/Teacher Actions – What should students be doing? What should teachers be doing to facilitate learning?

Note: Directions in italics represent a review of geometry.

1. Give each student a 10 cm-by-10 cm square piece of paper. *Talk about the attributes of a square and the ways to verify that the paper actually is a square.*
2. Have students fold the square along a diagonal. *It may be necessary to explain that a diagonal is the segment that joins two vertices that are not next to each other.* Have the students cut along the creased diagonal. Model this with a square of your own (Figure 1).
3. Discuss briefly with the students the two geometric figures they have now created — two congruent isosceles right triangles — and what they know about them. *Demonstrate the concept of congruence by placing one triangle on top of the other so that it looks like only one triangle.*
4. Have the students place one triangle aside and place the other in front of them with the long side toward their stomach, parallel to the edge of their desk. Have them fold this triangle into two congruent triangles. Model this with your own triangle (Figure 2).

5. Discuss briefly the two geometric figures they have now created — two congruent isosceles right triangles — and what they know about them. Again demonstrate the concept of congruence by placing one triangle on top of the other so that it looks like only one triangle. *Ask students if these right triangles are congruent to the one they put aside. This will provide the opportunity to discuss the difference between congruent and noncongruent.* Have the students label the smaller triangles *1* and *2.*
6. Have the students place the remaining large right triangle in front of them with the long side toward their stomach. Have them fold the vertex of the right angle down to the midpoint of the opposite side. Model this with your own triangle. Show them how it should look — a small triangle folded over a trapezoid. Cut along the crease. Label the new triangle *7* (Figure 3).
7. Discuss briefly the two geometric figures they have now created — an isosceles right triangle and a trapezoid. *If some students do not know what a trapezoid is, introduce it as a quadrilateral with exactly one pair of parallel sides.*
8. Have the students place the trapezoid in front of them with the longer side toward their stomach. Have them fold the trapezoid along the height of the trapezoid that connects the midpoints of the two bases. Model this with your own trapezoid. Cut along the crease. (Figure 4).
9. Discuss with the students the two geometric figures they have now created — two congruent trapezoids. *This is a good time to discuss the similarities and differences of the two trapezoids they have seen thus far.*
10. To assist students in following the next steps, place the following diagram of a "shoe" on the board or overhead.



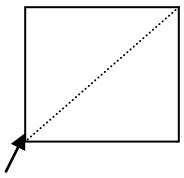
Say to students: "These are what we are now going to call shoes. You have two of them. Place one in front of you and put the other aside. Have them take the heel and fold it to the lace. Model this with your shoe. *It should look like a triangle folded over a parallelogram.* Cut along the crease. Label the small triangle "4" and the parallelogram "3" (Figure 5).

11. Have the students take the second shoe and place it in front of them, oriented the same as the model on the board or overhead. Take the toe and fold it back to the heel." Model with your own shoe. When the fold is complete, it should look like a triangle on top of a square. Cut along the crease. Label the triangle *6* and the square *5. Ask how they can verify that they have a square* (Figure 6).

Finish the discussion of geometric figures. *The students should now have a small isosceles right triangle and a parallelogram.* Is the triangle congruent or noncongruent to the others? Talk about the properties of a parallelogram.

12. Have the students make sure that they each have seven labeled pieces. Then have them put the seven pieces back together into the large square with which they started.
13. At the end of this activity, give each student an envelope with holes punched in it for a three-ring binder, and have them store their pieces for future work.

Figure 1.



crease and cut

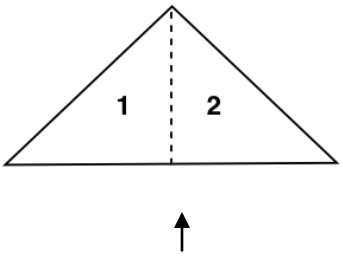
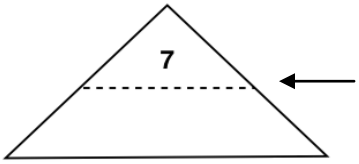


Figure 2

crease and cut



crease and cut

Figure 3.

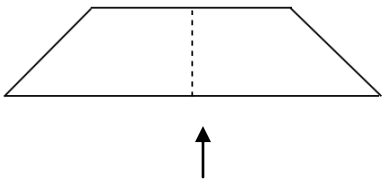


Figure 4. crease and cut

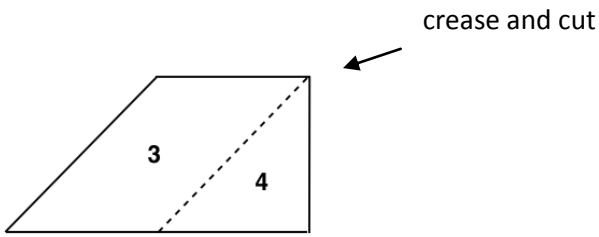


Figure 5.

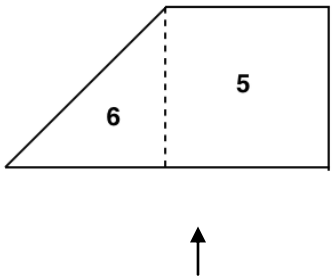
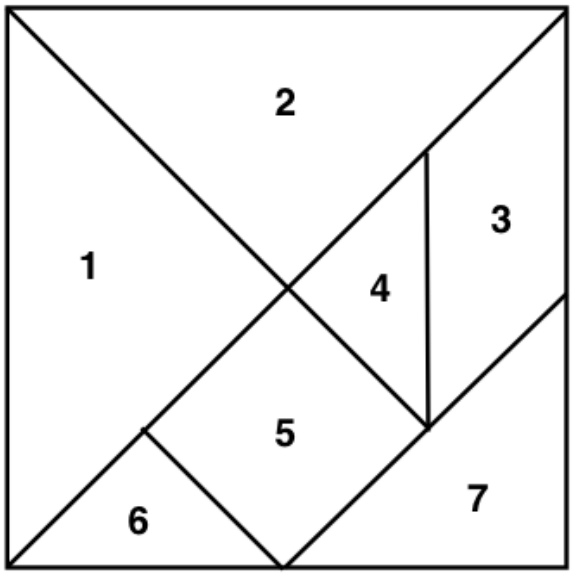


Figure 6. crease and cut

All Cracked Up — Area and Fractions with Tangrams

Steps

1. Identify each tangram piece by the name of its shape.
2. Which pieces have the same area? How do you know?
3. If the area of #5, the small square is 1 (one) unit, find the area of each numbered piece.



Piece #	Name	Area
1	_____	_____
2	_____	_____
3	_____	_____
4	_____	_____
5	square	1
6	_____	_____
7	_____	_____

Assessment

- **Questions**
  - Explain how a square, rectangle, triangle, rhombus, and trapezoid can or cannot also be named a parallelogram.
  - If you turn a square, does the name change?
- **Journal/writing prompts**
  - Draw a square, triangle, parallelogram using two isosceles, right triangles.
  - Draw a rectangle using two isosceles, right triangles and a parallelogram.
  - Draw a rectangle using two trapezoids.
- **Other**
  - Have students find examples of squares, rectangles, triangles, parallelograms, rhombi, and trapezoids in the classroom and record them.
  - Have students make a triangle, square, rectangle, and parallelogram using 2, 3, 4, 5, 6, and 7 parts of the tangram.

Extensions and Connections (for all students)

- Using a geoboard, have students create a square, rectangle, triangle, parallelogram, rhombus and trapezoid. Discuss the area of each shape starting with the square as a one by one.
- Distribute a copy of the handout "All Cracked Up — Area and Fractions with Tangrams" to each student. While the students are completing the handout, circulate and again discuss the strategies they are using to determine the fractional part of each piece.

Strategies for Differentiation

- Search for an interactive geoboard to allow students to create shapes.
- Pair students to assist each other with following directions and the physical manipulation of the paper.
- Demonstrate the cutting and also have a sample of the finished tangram pieces for the students to see.
- Divide students into 6 groups, giving each of them a shape. Have them create a poster explaining why their shape is the best.
- Play a word guessing game such as 20 questions.
- Have students create a picture of their favorite pastime using only triangles, squares, rectangles, parallelograms and trapezoids and rhombi.
- Create a word bank to help students identify each shape.
- Have shape names printed and cut for students to glue onto the recording sheet.
- Enlarge recording sheet for more space to write or allow students to use a separate sheet of paper to write answers.